
Ferroelectricity Newsletter

A quarterly update on what's happening in the field of ferroelectricity

Volume 8, Number 4

Fall 2000

SCIENTIFIC PUBLICATIONS PROLIFERATE

In the summer issue of the *Ferroelectricity Newsletter* we highlighted this year's International Symposium on Integrated Ferroelectrics. The main part of this issue is devoted to listing the oral and poster presentations at the **12th IEEE International Symposium on the Applications of Ferroelectrics** held 31 July to 2 August 2000 in Honolulu Hawaii.

ISAF 2000 General Chairs **Angus I. Kingon** and **Dwight Viehland** noted in their message that "the 409 contributions accepted for presentation in the meeting cover a large number of complementary topics, reflecting the breadth and depth of current activities in this interdisciplinary field."

Ferroelectricity is indeed an interdisciplinary field, a fact that is reflected in the scope of new publications. On pages 19 through 21 we will introduce you to a sample of these new publications.

The reports of *Technical Insights*, for instance, are extensive studies of key industries and technologies dealing with advanced ceramics, engineering polymers, nanophase materials, electronic materials, optical coatings, and quasicrystals. Each report, written by top technology analysts, is a guide for critical business decisions. In addition to an analysis and forecast of the market, each one sets forth the industry leaders, key players, and their strategic research.

Focusing on highly adaptive polycrystalline ceramics and other materials used in thin/thick devices, *Ferroelectric Devices* by Kenji Uchino offers chapters on the mathematical treatment of ferroelectrics, high permittivity dielectrics, ferroelectric memory, pyroelectric, piezoelectric, and electrooptic devices, PTC materials, and the future of ferroelectric devices.

Since electroceramics are playing an increasingly important role in many key technologies including communications, energy, electronics, electronic packaging, and automation, the *Journal of Electroceramics* has expanded its publication to six issues in 2000.

The fastest growing areas of solid state technology are presently dominated by thin-film devices and circuit assemblies. In five topical volumes, the *Handbook of Thin Film Devices* deals with the frontiers of research, technology, and applications.

We will continue to keep you abreast of any new developments in the field of ferroelectricity.

Rudolf Panholzer
Editor-in-Chief

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ISAF 2000 PAPERS

12TH IEEE INTERNATIONAL SYMPOSIUM ON THE APPLICATION OF FERROELECTRICS

The following is a list of titles and authors of oral and poster contributions given at ISAF, held 31 July -2 August 2000 in Honolulu, Hawaii.

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Chemical-solution processing and patterning of integrated ferroelectrics

D. Payne

Nonlinear behavior in piezoelectric ceramic transducers

S. Takahashi

The renaissance of diffraction methods: Electroactive materials studies

S. Misture

Measuring fracture toughness of PZT

T. Karastamatis and C.S. Lynch

Vibration amplitude distribution measurements on piezoelectric PZT/glass composite transducers for ultrasonic bio-cell filters

E. Benes, A. Frank, H. Böhm, M. Gröschl, F. Templer, and H. Novotny

Influence of electric field on R-curve behavior in BaTiO₃ and PZT

R. Niefanger, A. Kolleck, and G.A. Schneider

Time-resolved synchrotron X-ray scattering studies of ferroelectric thin films

S. Streiffer, C. Thompson, A. Munkholm, G. Stephenson, K. Ghosh, J. Eastman, O. Auciello, G. Bai, A. McPherson, J. Wang, R. Rao, and C. Eom

Local atomic structure and large piezoelectric response

T. Egami

Scanning nonlinear dielectric microscopy with nanometer resolution

Y. Cho, S. Kazuta, and K. Matsuura

Phases in relaxor ferroelectric crystals

C.-S. Tu, V.H. Schmidt, L.-F. Chen, and B.-C. Cheng

Dielectric losses in ferroelectric thin films by reversible domain wall motion

R. Waser

PIEZOELECTRICS AND ELECTROSTRICTORS

Cymbal transducer: A review

R. Newnham

A piezomotor for the small actuator market

L. Petit, P. Gonnard, and G. Gréhant

In-plant polarization for high sensitivity ferroelectric MEMS ultrasound transducers

J.J. Bernstein, J. Bottari, K. Houston, G. Kirkos, and R. Miller

Electrical biasing of PZT ceramic material

P. Bednarchik, and J. Hughes

Effects of substitution on electrical properties of (Bi_{1/2}Na_{1/2})TiO₃-based lead-free ferroelectrics

T. Takenaka

The variation of piezoelectric and electrostrictive strain as a function of frequency and applied electric field using an interferometric technique

W. Ren, A. Masys, G. Yang, and B. Mukherjee

Loss mechanisms in piezoelectrics

K. Uchino, J. Zheng, and Y.-H. Chen

Piezoelectric properties of PZT thick films on Si prepared by an interfacial polymerization method

T. Tsurumi, S. Ozawa, S. Wada, and M. Yamane

MEMS accelerometer using PZT films

R. Wolf, S. Troler-McKinstry, Y. Yang, L.-P. Wang, R. Davis, K. Chandra, K. Deng, W. Shanks, and T. Brooks

Trapped-energy vibratory gyroscopes using a partially polarized piezoelectric ceramic plate with plano-mesa structure

H. Abe, T. Yoshida, T. Ishikawa, N. Miyazaki, and H. Watanabe

Cylindrically shaped "W" membrane hydrophone

B. Jiao

Electrostrictive effect and load capability in electron irradiated P(VDF-TrFE) copolymer

Z.-Y. Cheng, T.B. Xu, V. Bharti, S.J. Gross, T. Maai, Q.M. Zhang, T. Ramatowski, L. Ewart, and R. Ting

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Electromechanical properties of piezoelectric spiral actuators

F. Mohammadi, B. Jadidian, A. Jain, A. Kholkin, S. Danforth, and A. Safari

The experimental SAW propagation characteristics of $\text{LiNbO}_3\text{NH}_3$ and LiTaO_3 with free and metallized surfaces

F. Hickernell

Crystal structure of the relaxor ferroelectric $\text{Pb}_2\text{ScTaO}_6$ in the paraelectric and ferroelectric states

K. Baba-Kishi and P. Woodward

Effect of microstructure on ferroelectric and piezoelectric behavior of PLZT systems

K. Ramam, D. Sastry, K. Trinath, N. Prasad, and A. Bhanumathi

Structure-property relations in sol-coated PMN ceramics: Microscopy, dielectric and electromechanical response

A. Sehirlioglu, C. Yoon, and S. Pilgrim

Piezoceramic thick films: Technology and applications state of the art in Europe

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Lead titanate ceramics for high frequency resonator

K. Hayashi, A. Ando, and Y. Sakabe

Multilayer bulk PZT actuators for flying height control in ruggedized hard disk drives

D.F.L. Jenkins, C. Chilumbu, G. Tunstall, W.W. Clegg, and P. Robinson

Piezoelectrically driven high-flow

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L. Saggere, H.Q. Li, D. Roberts, J. Steyn, K. Tner, J. Carretero, O. Yaglioglu, Y.-H. Su, N. Hagood, S.M. Spearing, and M.A. Schmidt

Internal fields in PT/P(VDF-TrFE) 0-3 composites

B. Ploss, B. Ploss, F.G. Shin, H.L.W. Chan, and C.L. Choy

From ferroelectric ceramics and single crystals to thick and thin films: How domain-wall processes control the piezoelectric properties

D. Damjanovic

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Low temperature MOCVD of BST thin film for high density DRAMs

H. Cho, J. Park, Y. Yu, J. Roh, and C. Kim

MOCVD deposition of BST thin films for future DRAM applications

J. Lindner, M. Schumacher, F. Schienle, D. Burgess, P. Strzyzewski, and H. Juergensen

Capacitance and admittance spectroscopy analysis of hydrogen-degraded $\text{Ba}_{0.7}\text{Sr}_{0.3}\text{TiO}_3$ thin films

R. Liedtke and R. Waser

Investigation of failure modes under AC and DC stress and implications for device reliability in LS-MOCVD $(\text{Ba,Sr})\text{TiO}_3$ thin films

C. Parker, S.-J. Kim, and A. Kingon

Narrow resonance profiling study of the oxidation of TiAlN and TaSiN barrier layers

F. Letendu, M. Hugon, J. Desvignes, B. Agius, L.

Vickridge, and A. Kingon

The effects of the composition on the step coverage of SrTiO_3 thin films

S. Park, J. Choi, and K. Ko

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Processing-microstructure-property relationships of CSD and MOCVD derived oxide thin films

S. Hoffmann

On the microwave sintering technology for improving the properties of electronic ceramics

I.-N. Lin, K.-S. Liu, and H.-F. Cheng

Ferroelectric property improvement of $\text{Pb}(\text{Zr,Ti})\text{O}_3$ films prepared by source gas pulsed-introduced MOCVD

H. Funakubo and K. Nagashima

Applications to photoconductor-ferroelectric memory of PZT thin films

M. Adachi, W. Wang, and T. Karaki

Hydrothermal synthesis of BaSrTiO_3 for applications in phased array antennas

B. Gersten and J. Synowczynski

Piezoelectric properties of perovskite-type BNKT ceramics textured by RTGG method

T. Tani, T. Takeuchi, E. Fukuchi, and T. Kimura

Fabrication and multilayer devices with ultrathin layers using electrophoretic deposition

J. Van Tassel and C.A. Randall
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integral electromechanics

D. Dimos

Fabrication of advanced functional ceramics by fused deposition technique

A. Safari, S. Danforth, M. Jafari, M. Allahverdi, B. Jadidian, F. Mohammadi, Y. Ito, and N. Venkataramam

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Mesoscopic symmetry and materials properties of multidomain PZN-PT single crystals

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Recent progress on the crystal growth of PMNT

Z. Yin and H. Luo

Intrinsic single domain and extrinsic domain wall contributions to response in ferroelectrics

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M. Zipparo and C. Oakley

Growth of potassium lithium niobate single crystals by the continue-charged Czchralski technique

T. Karaki, M. Makatsuji, and M. Adachi

Single crystal growth and electrical properties of high-T_c relaxor-PT system single crystals

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Effect of electrical boundary condition in ferroelectric phase transitions studied by thermal expansion and single crystal X-ray

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Miniaturized domain engineered multilayer actuators

B. Tuttle, P. Yang, E. Venturini, S. Nicolaysen, W. Olson, and G. Samara

Exploration of single crystal alkaline bismuth titanate piezoelectrics

Y.-M. Chiang, A.N. Soukhojak, A.S. Sheets, N. Ohashi, G.W. Farrey, J. Assai, G.R. Maskaly, and H. Wang

Intrinsic structural microinhomogeneity in 0.92Pb(Zn_{1/3}Nb_{2/3})O₃-0.08PbTiO₃ crystals

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Piezoelectric materials in the 21st century

Y. (John) Yamashita

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Growth and characterization of large high quality Pb(Mg_{1/3}Nb_{2/3})_{1-x}Ti_xO₃ by the Bridgman method

M.C.C. Custodio, Y.T. Fei, K. Zawilski, R. De Mattei, and R.S. Feigelson

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J.M. Powers, F. Nussbaum, and M.B. Moffett

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Aqueous-based processing of multilayer capacitor

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Synthesis and characterization of TiO₂ films for deep trench capacitor applications

U. Schroeder, R. Jammy, J. Bruley, P. DeHaven, K. Wong, and J. Shepard, Jr.

Fully embedded foil-based (PbLa)ZrTiO₃ thin films with base metal electrodes

J.-P. Maria, K. Cheek, S. Streiffer, and A. Kingon

Charge compensation in barium titanate

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R.G. Polcawich, C.-N. Feng, P. Vanatta, R. Piekarz, S. Kurtz, and S. Trolier-McKinstry

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Physical properties of (Ba,Sr)TiO₃ thin films used for integrated capacitors in microwave applications

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*Kington, A. Tombak, A.
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*C.-C. Su, S. Semenovskaya, B.
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Phenomenological treatment of lead
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*P. Hana, L.E. Cross, K. Uchino,
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*R. Meyer, R. Waser, J. Helmbold,
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Ferroelectric properties of
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*E. Colla, I. Stolichnov, A.
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*D. Hesse, A. Pignolet, C.
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*M. Ozgul, K. Takemura, S.
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*K. Nagata, J. Thongrueng, K.
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*M. Russell, D. Vestyck, S.
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*S.R. Summerfelt, T.S. Moise, T.
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*I.M. Reaney, R. Uvic, D. Iddles,
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Extrinsic loss mechanisms in of
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K. Akdogan and A. Safari

Microwave integrated circuits using
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Electrically tunable microwave
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*B.J. Gibbons, A.T. Findikoglu,
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Ferroelectric thin films on ferrites
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*J.M. Pond, S.W. Kirchoefer, H.S.
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Fast switchable devices based on
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W. Haase and F. Podgornov

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Crucial effect of the coupling coefficients on quasi phase-matched harmonic generation in an optical superlattice

Y.-Y. Zhu, S.-N. Zhu, and N.B. Ming

Ferroelectric emission studies for a lithographic application

I.K. Yoo, S.O. Ryu, J.K. Lee, B.M. Kim, and J.W. Chung

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Low cost multi-gas sensors based on uncooled pyroelectric detector arrays

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Aerogel isolated pyroelectric IR detector

T. Evans, S. Sun, J. Ruffner, and P. Clem

Characterization of sol-gel derived (Pb,Lu)TiO₃ pyroelectric thin film detectors

Y. Chen, C. Wang, Y. Huang, and M. Kao

SbSi films for IR imaging

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Electrostrictive and relaxor ferroelectric behavior of poly(vinylidene fluoride-trifluoroethylene) copoly-

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Q. Zhang, V. Bharti, Z.-Y. Cheng, H. Xu, S. Gross, T. Xu. T. Ramatowski, L. Ewart, and R. Ting

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New high performance monolithic bimorph piezoactuators

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New type of piezoelectric transformer with very high power density

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Design on Semiconductor coupled SAW convolver

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Current status of FET-type ferroelectric memories

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An analysis on retention characteristics in MF(M)IS structures for

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M. Okuyama, H. Sugiyama, K. Kodama, T. Nakaiso, and M. Noda

The mechanism and integration processes of MFMOS one transistor memory devices

T. Li, B. Ulrich, H. Ying, F. Zhang, and S.T. Hsu

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E. Tokumitsu and S. Imafuku

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Development of highly textured piezoelectric ceramics via templated grain growth

M.M. Seabaugh, G.L. Cheney, K. Hasinska, W.J. Dawson, and S.L. Swartz

Microstructure and polarization studies on modified SBNN

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Development of tube actuators with helical electrodes using fused deposition of ceramics

M. Allahverdi, B. Jadidian, B. Harper, S. Rangarajan, and M. Jafari

Fabrication of bismuth titanate components with oriented micro-

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Particle-shape control of molten salt synthesized lead titanate

Y. Ito, B. Jadidian, M. Allahverdi, and A. Safari

In-situ formation of internal 3-D electrodes for piezoelectric fiber composite actuators

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Progress in solid state conversion of high strain single crystal materials for navy applications

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Dielectric and electromechanical properties of (001)-textured PMN-PT

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Densification and stress development in sol-gel derived PZT layers

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Formation of lead titanate glass-ceramics from borate glasses

L.J. DeVore and J.E. Shelby

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Templated grain growth of tungsten bronze and perovskite ceramics

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Nanometer size metal platelets

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J.H. Adair, D.O. Yener, J. Sindel, and C.A. Randall

A new combinatorial process to fabricate PZT in self-assembly systems

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Selective deposition of solution-derived ceramic thin layers onto nonplanar substrates

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Principle of surface relaxation on $\text{ZnO}(0001)$ surface

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Maximizing electromechanical properties of PMN materials for ultrasonic transducers

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Uniaxial stress dependence of the piezoelectric properties of lead zirconate titanate ceramics

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Phase coexistence and properties of $\text{Pb}(\text{Zr}_{1-x}\text{Ti}_x)\text{O}_3$ - $\text{Sr}(\text{K}_{0.5}\text{ONb}_{0.75})\text{O}_3$ (PZR/SKN) solid solutions

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Nonlinear dielectric behavior of piezoelectric ceramics

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Investigation of piezoelectric properties in a new family of ferroelectric semiconductors $\text{Sn}_2\text{P}_2\text{S}_6$

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On the nature of a large piezoelectric anisotropy of heterogeneous ferroelectrics

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Texture engineering and enhanced piezoelectricity of Bi layer structured ferroelectric ceramics

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Theoretical analysis of SAW propagation characteristic in strained media and applications for temperature stable coupling SAW composite substrates

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A functionally graded piezoelectric material created by an internal

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The effect of processing parameter on the piezoelectric coefficients of thin films

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Preparation and piezoelectric properties of Pb(Zr,Ti)O₃ thick films on silicon

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Size effects in nanophase KPbTiO₃

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E.K. Akdogan and A. Safari

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Ferroelectricity Newsletter

including all back issues is available on Internet

<http://www.sp.nps.navy.mil/projects/ferro/ferro.html>

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PUBLICATIONS

***SIX EXTENSIVE STUDIES OF KEY INDUSTRIES AND TECHNOLOGIES:
TECHNICAL INSIGHTS***

Published by John Wiley & Sons, Inc., *Technical Insights* brings extensive studies of the following key industries and technologies:

Advanced Ceramics

Covering a broad spectrum of cutting-edge advanced ceramics, this report brings exciting applications that are in development:

- Ceramic components in fuel cells for near-emission-free engines
- Cockpit armor for military aircraft
- Oil spill containment booms
- A prosthetic eye that looks and moves like a real eye
- A gelcasting technique that can be used to make silicon nitride nozzles, blades, and wheels
- Fused deposition modeling of commercial grade silica powder
- Superplastic net-shape forming of nanophase ceramics

Engineering Polymers

The polymer/plastics industry has grown to be larger than the aluminum, copper, and steel industries combined. This report examines the potential for market growth in the automotive, aviation/aerospace, electrical/electronic composites, medical, and industrial/consumer sectors. It also looks at ongoing advances in composite bonding, fabric prepreg, photopolymerization, selective laser sintering, probes for detecting motions, injection molding, plastics recycling, stereolithography, and two-shot molding.

Nanophase Materials

Nanomaterial applications include nanoelectronics, metallurgy, biotechnology, cosmetics, space exploration, nanomedicine, optics, food industry, metrology and measurement, ultraprecision engineering, and pharmaceutical and chemical industries. In this report you will learn about

- Electronic thin films, nanowires, quantum dots
- Trend toward small in macro-world and micro-world
- Computer speed and memory jumps
- Molecular devices that hold random access memory (RAM)
- Vast storage capacity
- Competitor for Group III-V materials: nanophase Si
- Potential to lower cost, smaller, faster, more versatile products

Optical Coatings

Prospects for this burgeoning field are expanded functions beyond antireflectors-chemical, environmental, and abrasion resistance; climate control; EMI shielding; optical fibers and filters; transmissive electrodes; electronic display screens; and architectural and automotive windows and mirrors. *Optical Coatings* examines five key areas with important recent advances:

- New sputtering techniques for large areas
- Sol-gel technology for ferroelectric thin films, nanocomposites, thermal barrier coatings, and more
- Suspended particle device technology, a revolutionary material for smart windows, mirrors, sunroofs, and sunvisors
- Diamond-like carbon coatings for wear/corrosion protection of magnetic storage media; low-dielectric insulators for interconnects of ultra-large integration chips
- Amorphous coatings that exhibit minimal light scattering

PUBLICATIONS

Quasicrystals

Novel materials spur markets for composites, surface coatings, thermoelectric devices, and hydrogen storage.

This report features

- description of the scientific and technological nature of quasicrystals and their benefits
- overview of the major players in the field. Leading centers of research are listed alphabetically and by country
- highlights of current research; covers research into applications for quasicrystals and basic research.

***COMPREHENSIVE INTRODUCTION TO FUNDAMENTALS OF FERROELECTRICS
FERROELECTRIC DEVICES***

by **Kenji Uchino**

This versatile reference/text provides information about available materials, device designs, drive/control techniques, and essential applications and examines high-permittivity dielectrics, piezoelectric devices, pyroelectric sensors, and electrooptic devices.

Featuring the author's exclusive device development method, ***Ferroelectric Devices***

- analyzes multilayer, bimorph/moonie, and flexible composites
- explains the uses of PTC (positive temperature coefficient of resistivity) effects
- covers electrostriction, anharmonicity, polarization reversal, paraelectricity, and other phenomena
- illuminates ferroelectric volatile and nonvolatile memory development
- showcases "sensing" and "activating" functions in pyroelectric and piezoelectric materials
- examines Eigen lattice vibration modes in various crystals
- describes shear stress and strain configurations
- surveys applications of ferroelectric ceramic multilayer structures in capacitors, actuators, and electrooptic components.

Containing more than 800 references, drawings, and photographs, ***Ferroelectric Devices*** serves as an excellent reference for materials, electrical, electronics, optical, electromechanical, solid-state, and robotics engineers, and a superb text for upper-level undergraduate and graduate students in these disciplines.

HANDBOOK OF THIN FILM DEVICES: FRONTIERS OF RESEARCH, TECHNOLOGY, AND APPLICATIONS

by **Maurice H. Francombe**

The fastest growing areas of solid state technology are presently dominated by thin-film devices and circuit assemblies. Requirements in the commercial, military, and space development arenas have resulted in a greatly increased focus on micro-volume devices and circuit architectures in high-density, integrated solid-state subsystems. Such subsystems often embody, in addition to electron devices, newly developed magnetic, superconducting, dielectric, acoustic, and optical thin film components, providing functions not otherwise available in semiconductors.

This handbook is the first multi-topical review and comprehensive reference work to address these interdisciplinary needs. The five topical volumes have been organized by editors who are well-known authorities in the areas of semiconductor, optical, superconducting, magnetic, and ferroelectric film devices. The close familiarity and involvement of these editors with thin film device research and development programs in government, industry, and university laboratories, has ensured that world-recognized experts from these institutions were invited to contribute and review chapters. The result is a well-balanced selection of articles, covering all aspects of thin film devices ranging from basic device physics and design, through growth and device fabrication, performance characteristics, to applications and integrations into subsystems.

PUBLICATIONS

The volume headings of the *Handbook of Thin Film Devices* are:

Volume One

Hetero-Structures for High Performance Devices, edited by Colin E.C. Wood

Volume Two

Semiconductor Optical and Electro-Optical Devices, edited by A.G.U. Perera and H.C. Liu

Volume Three

Superconducting Film Devices, edited by Phillip Broussard

Volume Four

Magnetic Thin Film Devices, edited by J. Douglas Adam

Volume Five

Ferroelectric Film Devices, edited by Deborah J. Taylor

JOURNAL OF ELECTROCERAMICS

Editor-in-chief Harry L. Tuller

Electroceramics are playing an increasingly important role in many key technologies including communications, energy, electronics, and electronic packaging, and automation. This derives from their versatility in:

- piezo-, ferro-, and pyroelectricity
- electro- and nonlinear optical properties
- ferromagnetism
- insulating to metallic and fast ion conductivity

These, combined with thermal, mechanical, and chemical stability in aggressive environments often render them the only viable materials choice. The performance of electroceramic materials depends on a complex interplay between processing, chemistry, and structure.

For the first time, *Journal of Electroceramics* provides as forum for discussion cutting across issues in electrical, optical, and magnetic ceramics. Driven by the need for miniaturization, cost, and enhanced functionality, the field of electroceramics is experiencing for rapid growth in many new directions. The journal encourages discussions of resultant trends concerning silicon-electroceramic integration, ferroelectric memories, high and low dielectric materials, nanotechnology, sensors, actuators, ceramic-polymer composites, grain boundary, and defect engineering.

Journal of Electroceramics publishes original research papers on both scientific and technical aspects of electroceramics. On a timely basis feature articles and special issues serve to highlight recent progress and future trends in the various subfields.

They include the areas of oxide electronics, ionic and mixed conductors, actuators and sensors, boundary controlled devices, electronic packaging, dielectrics, optoelectronics, magnetic recording, and superconductivity.

UPCOMING MEETINGS

**“Active Materials: Behavior and Materials”
Part of SPIE's 8th International Symposium on Smart Structures and Materials
5–8 March 2001**

Newport Beach Marriott, Newport Beach, California, USA

Smart structures utilize active materials as sensors and actuators to sense and respond to their environment. These include piezoelectrics, electrostrictives, magnetostrictives, and shape memory alloys (SMA). Development of smart structures involves the integration of active and passive materials systems, often including the coupling of relevant mechanical, electric, magnetic, thermal, or other physical properties. This can subject the active materials to large stress levels, cyclic loads, thermal loads, or environmental loads that result in degradation of material properties. Meeting the materials needs of the smart structures community over the coming decade and beyond will require the development of new active materials, further characterization of new and existing active materials, and developing models of material behavior and material failure suitable for reliable structural design. This conference will bring together researchers from the materials, mechanics, and applications communities with common interests in material properties.

Topics**Development of Active Materials**

- Single crystal and polycrystalline materials: Ferroelectrics, SMA, and magnetostrictives
- High-temperature ferroelectrics and SMA
- Ferromagnetic SMA
- Low-temperature magnetostrictive materials
- Thin film active materials for structural applications, e.g., flow control

Active Materials Characterization

- Constitutive behavior: Composition/structure/property relations, coupled field characterization, micromechanics models, macro scale models
- Reliability: Fracture toughness, fatigue crack growth, field coupled fracture, fracture mechanics of active materials, fatigue life prediction for both SMA and ferroelectrics, other failure models and mechanisms, e.g., aging, depoling, dielectric breakdown, Curie temperature, creep, etc.

Active Composite and Structural Elements

- Ferroelectric composites (including unimorph, bimorph, patch), SMA composites, magnetostrictive composites, smart polymer composites, hybrid active material systems, cofired and stack ferroelectric actuators, torque tubes

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Upcoming Meetings

6th International Symposium on Ferroic Domains and Mesoscopic Structures (ISFD-6)	29 May-2 Jun 00	No.1, p.12
MRS Workshop on High- <i>k</i> Gate Dielectrics	1-2 Jun 00	No.1, p.13
MRS Workshop on Transparent Conducting Oxides (TCOs)	19-20 Jun 00	No.1, p.14
12th American Conference on Crystal Growth and Epitaxy (ACCGE-12)	13-18 Aug 00	No.1, p.15
3rd (8) International Seminar on Ferroelastics Physics [ISFP-3(8)]	11-14 Sep 00	No.2, p.16
Materials Week	25-28 Sep 00	No.2, p.17
SPIE's 2000 Symposium on Microelectronic Manufacturing	18-19 Sep 00	No.3, p.29
2000 Fall Materials Research Society Meeting	27 Nov-1 Dec 00	No.3, p.30
13th International Symposium on Integrated Ferroelectrics (ISIF 2001)	11-14 Mar 01	No.3, p.32
2001 Spring Materials Research Society Meeting	16-20 Apr 01	No.3, p.33
8th International Conference on Ferroelectric Liquid Crystals (FLC 2001)	5-11 Aug 01	No.3, p.34
10th International Meeting on Ferroelectricity (IMF-10)	3-7 Sep 01	No.3, p.35
"Active Materials: Behavior and Mechanics," Part of SPIE's 8th International Symposium on Smart Structures and Materials	5-8 Mar 01	No.4, p.22

Conference Reports

12th International Symposium on Integrated Ferroelectrics (ISIF 2000) Aachen	12-15 Mar 00	No.3, p.2
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2nd Asian Meeting on Ferroelectricity (AMF-2), Singapore	7-11 Dec 98	No.1, p. 2
17th Conference on Crystal Growth and Epitaxy, Fallen Leaf Lake, California	4-7 Jun 00	No.1, p.10
9th European Meeting on Ferroelectricity (EMF-9) Prague	12-16 Jul 99	No.2, p. 2
12th International Symposium on Integrated Ferroelectrics (ISIF 2000) Aachen	12-15 Mar 00	No.3, p.11
12th IEEE International Symposium on the Application of Ferroelectrics (ISAF 2000)	31 Jul-2 Aug 00	No.4, p.2

Publications

<i>Technical Insights</i>	No.4, p.19
<i>Ferroelectric Devices</i>	No.4, p.20
<i>Handbook of Thin Film Devices</i>	No.4, p.20
<i>Journal of Electroceramics</i>	No.4, p.21

IEEE Sensors Journal

This new, peer-reviewed professional society journal devoted to sensors is now accepting paper submissions and subscriptions for 2001.

The journal is organized by a group of dedicated volunteers and is backed by the IEEE Sensors Council. The council consists of 26 member societies with a combined membership of 260,000. The call-for-papers and other relevant information can be found on the Sensors Council website: www.ieee.org/sensors.

The IEEE Sensors Journal will start publication in June 2001. The inaugural issue is being dedicated to review papers – 41 such papers are in preparation.

For the list of titles and subscription information, please visit the website.

CALENDAR OF EVENTS 2000

Nov 27- Dec 1	• MRS 2000 Fall Meeting, Boston, Massachusetts, USA (see p. 30)
Dec 3-6	• Session on "Tunable Microwave Devices and Circuits," Asia Pacific Microwave Conference (APMC 2000), Sydney, Australia. Contact: gsubrama@engr.udayton.edu
Dec 12-15	• 3rd Asian Meeting on Ferroelectrics (AMF-3), Hong Kong, China (see <i>Ferroelectricity Newsletter</i> , Vol. 7, No. 3, p. 19)
2001	
Mar 5-8	• "Active Materials: Behavior and Mechanics (ss08)," Part of SPIE's 8th International Symposium on Smart Structures and Materials, Newport Beach, California, USA (see p. XX)
Mar 11-14	• 13th International Symposium on Integrated Ferroelectrics (ISIF 2001), Colorado Springs, Colorado, USA (see p. 32)
Apr 16-20	• MRS 2001 Spring Meeting, San Francisco, California, USA (see p. 33)
Aug 5-11	• 8th International Conference on Ferroelectric Liquid Crystals (FLC 2001), Washington, D.C., USA (see p. 34)
Sep 3-7	• 10th International Meeting on Ferroelectricity (IMF-10), Madrid, Spain (see p. 35)